Spatial Analysis for Change Detection Of Geographical Entities Using Object Based Modeling Approach

I Introduction

Land is vital to the survival of all life on Earth and it is important that we understand the various changes that take place on it. Environmental and anthropogenic drivers are constantly changing the face of the Earth and it is essential that we understand what these drivers are and the change they bring about to the Land use/Land cover. Land Use Land Cover (LULC) change analysis is very important for environmental management purposes as it helps the decision maker in planning for future changes that may occur in that area and it also helps the decision maker realize the effects of these changes on humans and their environment. [1] Decision makers also have to identify, what are the factors that affect the LULC change (such as population, agricultural growth etc.). Therefore the quality of the LULC change map is essential for making more accurate decisions. In this project, uncertainty modeling has been performed in Land use/cover change. Uncertainty modeling quantifies the variation in results obtained by a modeling process for decision-making. [7]

Remote Sensing and Geographical Information Systems apply different types of operations (e.g. classification, rescaling) on spatial datasets to produce maps or to extract spatial information from the dataset; there is always some uncertainty in these operations. Uncertainty considers aspects like error and incompleteness of the input data as well as the output data. [2][4]. LULC change is detected by using different time period images and various driver datasets (e.g. soil moisture, temperature, and slope). There is some amount of uncertainty in the available observation, spatial distribution and resolution of the datasets. We have to model the redistribution and aggregation uncertainty for the driver data in order to come up with an outcome that has minimum error. Spatial aggregation is used in conversion of LULC datasets to thematic raster datasets. The spatial aggregation methods used for this project are Random role based and Major role-based. [3] The results show that major rule -based aggregations proved to

be more accurate than random rule-based aggregations. The highest percentage of change was observed in the classes; snow and ice and barren land.

The land use map is a useful resource to support the decisions of the city planners, economist, and ecologist and for every decision-maker involved in the sustainable development of the territory. The recent availability of remote sensing imagery with high spatial resolution and the land-use thematic characterization performed in automatic way bring to derive spatial dataset with good accuracy. Furthermore recent researches showed the advantages to adopt an object based classification instead of a classical per pixel solution. For this reason we present an application based on a hybrid classification implemented in the object based. The classification is performed on a set of multi-spectral images combined with pseudo bands [5][7]. Following the cover assignment to the polygon entities is realized applying some fuzzy rules based on membership class percentage and spatial metrics to infer more Land use categories. Generally the identification of specific land use classes by remote sensing data is very problematic. In fact some areas are spatially heterogeneous and with similar spectral response (i.e. artificial landscape).

The artificial cover consists of several different structures like buildings, roads, gardens or other vegetation areas, which make complex to analyze the urban and suburban landscape. Some studies describe the possibility to use the information coming from the landscape metric analysis to put in evidence some urban land use structures and changes in the urban growth (Herold et al., 2002(a), Herold et al, 2002(b)). In fact the landscape metrics applied to urban segmented areas can help to perform an useful separation between high and low density residential class.The landscape metric investigation applies the basic concepts of the conventional visual interpretation that defines the photometric regions in term of "homogeneous structures" characterized by similar size, density and spatial pattern. [8] [9]

The environmental indicator related to the pattern of the landscape are quantitative indices based on the fractal geometry focused on the structural analysis of patches, defined as homogeneous entities with similar attribute. This quantitative analysis can be adopted to analyze the structural complexity and the fragmentation of the urban environment in contrast to the natural areas. These are good information to apply in a rule based system to describe the urban morphology. However it is necessary to have image with very high spatial resolution, as those coming from

the new satellite sensors systems or digital airborne camera (IKONOS, Quickbird, Leica ADS40, and so on). [3]

What is change detection study?

"Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times"
(Singh, 1989)
.
"Timely and accurate change detection of Earth's surface features provides the foundation for better understanding 3 relationships and interactions between human and natural phenomena to better manage and use resources " (Lu et al 2004)
.
Changes in land cover by land use do not necessarily imply degradation of the land.
However, due to a shift in land use patterns
,
land cover changes that affects bio diversity, water and other processes that come together to affect climate and biosphere (Riebsa meet al ., 1994)
.
A detailed understanding of the impact of mining on changes in land use/land cover
pattern has become necessary for the Sukinda valley . Therefore, present study was undertaken to analyze the extent of human

What is GIS?

According to the views of various GIS authors, the definitions of GIS became additional versatile, however normally, a geographic data system, is any system that captures, stores, analyzes, manages, and presents knowledge that are coupled to a physical location, within the simplest terms, GIS is that the merging of making and information technology. GIS systems are utilized in making, remote sensing, land measure, utility management, photogrammetric, geography, urban designing, emergency management, navigation, and localized search engines. As GIS could be a system, it's boundaries that will be territorial, purpose or application orientated that a particular GIS is developed. Hence, a GIS developed for associate in nursing application; jurisdiction or purpose might not be essentially practical or compatible with a GIS that has been developed for a few alternative application, jurisdiction or purpose. What goes on the far side GIS is spacial knowledge infrastructure (SDI), a thought that has no such restrictive boundaries. Therefore, in an exceedingly general sense, the term describes any data system that integrates stores, edits, analyzes, shares, and displays geographic data, in an exceedingly

additional generic sense, GIS applications are tools that permit users to form interactive queries (user-created searches), analyze spacial data, edit data, maps, and gift the results of these operations. A GIS is Associate in nursing data system designed to figure with knowledge documented by spacial / geographical coordinates. In alternative words, GIS is information system with specific capabilities for spatially documented knowledge still as a collection of operations for operating with the information, it should even be thought of as a better order map. GIS technology integrates common information operations like question and applied mathematics analysis with the distinctive visualization and geographic analysis advantages offered by maps. These skills distinguish GIS from alternative data systems and build it valuable to a large varies of public and personal enterprises for explaining events, predicting outcomes, and designing ways. A Geographic data system could be a pc based mostly system that is employed to digitally reproduce and analyze the feature gift on earth surface and also the events that occur thereon. Within the lightweight of the very fact that nearly seventieth of the information has geographical reference as its divisor, it becomes imperative to underline the importance of a system which might represent the given knowledge geographically. A typical GIS can be understood by the help of few more definitions given below:-

- A geographic information system (GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on Earth.
- Burrough in 1986 defined GIS as, "Set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes" .
- Arnoff in 1989 defines GIS as, "a computer based system that provides four sets of capabilities to handle geo-referenced data :
    - ✓ Data input
    - ✓ Data management (data storage and retrieval)
    - ✓ Manipulation and analysis
    - ✓ Data output.

Hence GIS is looked upon as a tool to assist in decision-making and management of attributes that needs to be analyzed spatially.

Research Questions:

The underlying basis of this study is that there have been considerable LULC Changes in the Saugahatchee sub - watershed which have had a detrimental impact on the water quality in portions of the watershed.

In this investigation the following research questions are posed:

1) Can improvements be made to traditional multi-spectral Pixel Based land use land cover classification through Object Based Image Analysis?
2) What are the major driving forces for the land use and land cover changes?
3) What will be the extent of the land use and land cover changes in the future?

Problem Statement:

Nanded is most celebrated town with vast quantity of public and personal sectors industrial institution and infrastructure and range of residential colonies. With the increment, settled areas in Nanded are speedily increasing and it's evading to many environmental consequences (air and pollution, traffic jam, urban heat island formation, etc.) thus the urban surroundings in Nanded is underneath severe stress attributable to the

pressure of fast urbanization. Consequently urbanization has deteriorated the quality of the urban surroundings in Nanded. so as to mitigate and minimize the damaging effects related to urban growth Land Use Land cover Change Detection is additional important.

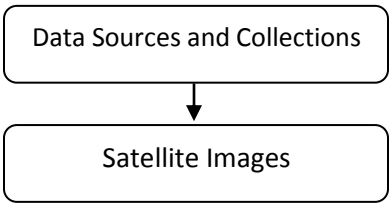
Motivation of Study:

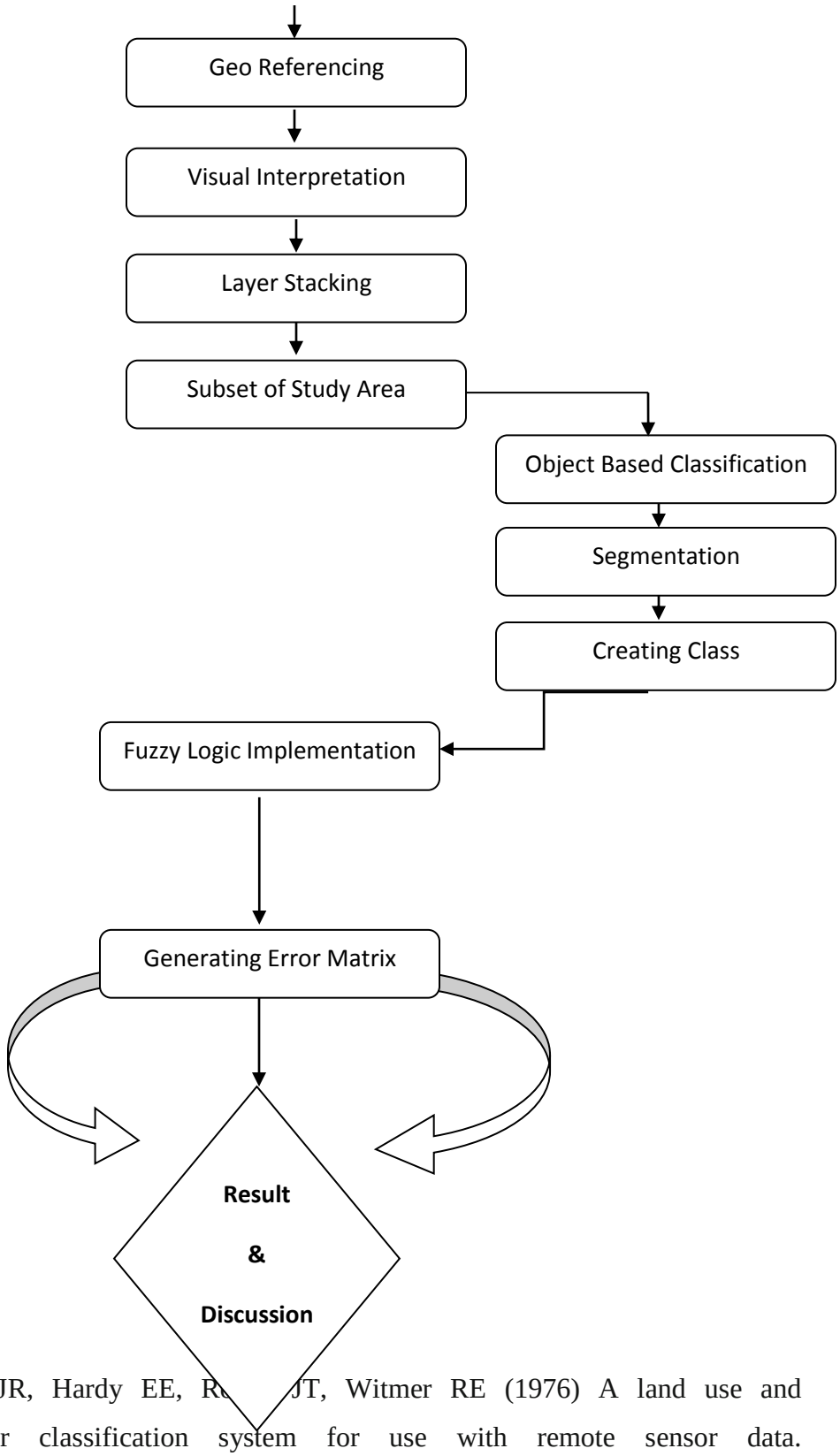
With recent development of remote sensing technologies and accumulated remotely detected knowledge accessibility, distinctive elaborate abstraction and temporal modifications of urban areas and observation urban growth and LULC change became additional price effective and success. For higher observation regional advanced LULC modification, additional comprehensively understanding the causes and consequences of urban enlargement, and additional accurately distinctive typical patterns and trends needed by planners and policy manufacturers for higher future designing and environmental management future statistic dynamic LULC modification analysis is important.

Objectives of Study:

1) To create a land use land cover classification scheme
2) To generate statistical data on land consumption by different classes
3) Study of Classification techniques
4) Examine spatial transitions between different Land use categories
5) To determine the trend, nature and magnitude of Land use Land cover change

Research Methodology:





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